PATENT
Docket No. 506212000600

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Nadine E. Johnson

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In the application of:

Michihiko YANAGISAWA *et al.*

Serial No.: 10/098,588

Filing Date: March 18, 2002

For: WAFER TABLE FOR LOCAL DRY ETCHING APPARATUS

Examiner: Ram N. Kackar

Group Art Unit: 1763

APPELLANTS' OPENING BRIEF

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is a timely appeal from the final rejection of claims 2, 3, 8 and 9 in this application.

I. REAL PARTY IN INTEREST

The real party in interest is SPEEDFAM Co., Ltd., of Ayase, Japan, the assignee of appellants' entire, right, title and interest in this application.

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences within the meaning of 37 CFR 1.192(c)(2) known to appellants or their undersigned counsel.

III. STATUS OF CLAIMS

Claims 2, 3, 8 and 9 (reproduced in the attached Appendix), which are under final rejection, and claims 4-6, which have been withdrawn from consideration, are pending in this application. Claims 1 and 7 have been cancelled.

Claims 2, 3, 8 and 9 have been finally rejected under 35 USC 112, second paragraph, and under 35 USC 103(a) over Yanagisawa in view of Shinozuka.

IV. STATUS OF AMENDMENTS

Appellants filed the Response Under 37 CFR 1.116 on May 11, 2004, in response to the final Action dated January 14, 2004, without amending of claims, so the claims on appeal stand as presented in the Amendment Under 37 CFR 1.111 filed December 16, 2003.

V. SUMMARY OF THE INVENTION

The invention is a local dry etching apparatus and a wafer table for supporting the local dry etching apparatus. FIG. 4 of the application generally shows the constructions of the claimed invention. Gas supply apparatus 3 feeds a source gas, such as SF_6, to plasma generator 1 for producing activated species G, which is injected onto semiconductor wafer W placed on wafer table 40 that is maintained in vacuum chamber 4. X-Y drive mechanism 5 moves the wafer table 40 so that the exposure time of the wafer W to the activated species G corresponds to a local thickness deviation of the wafer 4 that has been determined prior to the etching process.

Appellants have found that the edge portion of wafer W is over-etched when the wafer table 40 is larger than the wafer W by more than a certain amount, as shown in FIG. 5, and that the edge portion is under-etched when the wafer table 40 has substantially the same size as the wafer W, as shown in FIG. 7. Only when the wafer table is larger than the wafer W within a certain amount, as shown in FIG. 6, the edge portion of the wafer W is etched in the same

manner as the central portion of the wafer W is etched. Appellants quantified this "certain amount" by comparing the size difference between the wafer W and the wafer table 40 to the half value width d of the etching rate distribution peak shown in FIG. 2 of this application. FIG. 12 shows the results of appellants' experiments. When the difference between the wafer table 40 and the wafer W is 10 to 40% of the half value width of the etching profile, the edge portion of the wafer W is not over-etched or under-etched.

VI. ISSUES PRESENTED FOR REVIEW

Whether the Examiner erred in rejecting claims 2, 3, 8 and 9 under 35 USC 112, second paragraph.

Whether the Examiner erred in rejecting claims 2, 3, 8 and 9 under 35 USC 103(a) over Yanagisawa in view of Shinozuka.

VII. GROUPING OF CLAIMS

Claims 2, 3, 8 and 9 stand or fall together with respect to the rejection under 35 USC 112, second paragraph.

As to the rejection under 35 USC 103(a), however, claims 2 and 8 stand or fall together and claims 3 and 9 stand or fall together separately from claims 2 and 8.

VIII. ARGUMENT

A. Claims 2, 3, 8 and 9 Are Not Indefinite.

In the final Action, the Examiner explained the indefiniteness rejection as follows:

> In these instances the radius of supporting face of wafer table is compared to objects whose length is variable. See MPEP 2173.05(b). In claims 2 and 8 in addition to comparing support face size to substrate, it is also compared to an indefinite length parameter "half value width" referred to in the specification.

Final Action page 2. The Examiner supplemented this explanation in the Advisory Action, stating that "[t]he rejections[1] based on 35 USC 112 stand because the applicant has not provided

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[1] The Examiner seems to have misspoken in referring to "rejections" under 35 USC 112 since only one such rejection is of record.

any reason why half value width would be a definite length in view of it clearly depending on the process parameters." Thus, the Examiner's basis for the rejection is two-hold, i.e., 1) the half value width is indefinite, and 2) the claims are indefinite because the size of the wafer table is compared to the size of the wafer and the half value width that vary depending on process conditions. Both of these arguments are factually and legally incorrect.

1. The "Half Value Width" Language Is Not Indefinite Because It Provides Clear Warning To Others As To What Would Constitute Infringement Of The Patent.

MPEP 2173.02 explains the application in examination of 35 USC 112, second paragraph, as follows:

> In reviewing a claim for compliance with 35 U.S.C. 112, second paragraph, the examiner must consider the claim as a whole to determine whether the claim apprises one of ordinary skill in the art of its scope and, therefore, serves the notice function required by 35 U.S.C. 112, second paragraph by providing clear warning to others as to what constitutes infringement of the patent. ... The test for definiteness under 35 U.S.C. 112, second paragraph is whether those skilled in the art would understand what is claimed when the claim is read in light of the specification.

Under this standard, the Examiner's analysis is defective since it fails to take into account the level of skill of persons skilled in the art and does not apply common sense to determine whether such persons skilled in the art would get clear warning, i.e., would be able to understand, of what the claims cover.

The Examiner failed to appreciate the meaning of the term "half value width" in the first Action, so appellants explained in the amendment filed December 16, 2003 that a half value width is the width of a peak at its half maximum value. Appellants also provided the Examiner with supporting references along with an example that the half value width of a Gaussian distribution, $\exp(-x^2/2\sigma^2)$, is the width of the Gaussian peak at one half of the peak value, $2\sqrt{(2\ln 2)}\sigma$. In the final Action, even though the Examiner agreed to the definition of the half value width provided by appellants, he argued that "since this length depends upon an etch profile which depends upon the units of time, units of depth, processing parameters and material

of etch, this length could not be used as a standard unless these parameters are defined." Final Action, pages 3 and 4. Accordingly, the Examiner took the position that the half value width of the etching rate distribution peak is indefinite unless all the parameters of the etching process and related measurement of the etching profile are determined.

When evaluating whether a given apparatus meets the claim requirements for the expression "half value width of an etching rate distribution peak of the gas injected from the nozzle" of the claimed apparatus and wafer table for locally etching a semiconductor wafer, persons skilled in the art would first choose the semiconductor material for the etching, typically a silicon or a compound semiconductor, determine the processing conditions including the type of activated species gas used and the flow rate of the gas, and etch the semiconductor material with the gas for a unit time based on the teaching in the specification that the etching rate distribution peak is obtained by etching for a unit time, which is one minute in this art as appellants demonstrated with reference to the prior art submitted with the Response filed May 11, 2004. Once an etching rate distribution peak, such as the one shown in FIG. 2 of this application, is obtained by measuring the etch pit formed by the one-minute etching, persons skilled in the art would then measure the half value width of the obtained peak and compare the measured half value width to the wafer table size and the wafer size in order to determine whether the apparatus they are using is covered by the claims.

Thus, the term "half value width" provides clear warning to others as to what constitutes infringement of the patent when the claims are read in light of the specification. Accordingly, the half value width is not indefinite.

2. Claims That Include Relative Terminology Are Not Indefinite Under *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.* and *Ex Parte Brummer.*

The Examiner refers to the statement in MPEP 2173.05(b) that reference to an object that is variable may render a claim indefinite and contends that the size limitation of the wafer table compared to the wafer size and the half value width makes the clams indefinite.

In *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.*, 806 F.2d 1565, 1576, 1 USPQ2d 1081, 1111-1112 (Fed. Cir. 1986), a case which involved an invention directed to a wheel chair with claims stating "wherein said front leg portion is so dimensioned as to be insertable through the space between the doorframe of an automobile and one of the seats thereof," the court stated that:

> It is undisputed that the claims require that one desiring to build and use a travel chair must measure the space between the selected automobile's doorframe and its seat and then dimension the front legs of the travel chair so they will fit in that particular space in that particular automobile. ... The claims were intended to cover the use of the invention with various types of automobiles. That a particular chair on which the claims read may fit within some automobiles and not others is of no moment. ... As long as those of ordinary skill in the art realized that the dimensions could be easily obtained, §112, 2d para. requires nothing more.

In *Orthokinetics*, the size of the front leg portion of the wheel chair that was compared to the space between the doorframe and the seat of an automobile varied depending on specific type of automobile, whereas in this case the size of the claimed wafer table is compared to the size of the wafer and the half value width that may vary depending on the processing conditions.

The claims of this invention also require persons skilled in the art to select a wafer for the etching process, to measure the half value width of the etching rate distribution beak appearing on the selected wafer, and then to compare the size of his wafer table to the size of the selected wafer and the half value width as specified in the claims. As was the case with Orthokinetics' wheel chair, appellants' claims too are intended to cover the use of the invention with various types of semiconductor wafers and etching processes that result in various half value widths. Because persons skilled in the art can easily obtain the variable dimensions, i.e., the wafer size and the half value width of the etching rate distribution peak, as explained above, the claims are not indefinite under 35 USC 112, second paragraph.

To support his argument, the Examiner relies on *Ex parte Brummer*, 12 USPQ2d 1653, 1655 (Bd. Pat. App. & Intf. 1989), which dealt with a claim that stated "said front and rear

wheels so spaced as to give a wheelbase that is between 58 percent and 75 percent of the height of the rider that the bicycle was designed for. The Board stated as follows:

> In the case before us here, it is our opinion that one would be at a loss to determine whether a particular bicycle is covered by claim 9. No evidence has been made of record to show that a known "standard" exists in the field of bicycle manufacturing for sizing a bicycle to a rider. Therefore, a bicycle could be considered by the appellant to fall within the scope of claim 9, because on the basis of the standards he uses to size a bicycle to a rider the wheelbase is between 58 and 75 percent of the height of the rider "that the bicycle was designed for," while the manufacturer of the bicycle believes it does not, on the basis of his standards for sizing, which are different. This being the case, whether the bicycle was covered by the claim would be determined not on the basis of the structural elements and their interrelationships, as set forth in the claim, but by means of a label placed upon the bicycle at the discretion of the manufacturer.

The Board refused to credit Brummer's argument that there was a standard for sizing a bicycle to a rider, i.e., "that the bicycle was designed for," because such a standard was merely an arbitrary label and was not based on the structural elements and their interrelationship.

The "standard" of the comparison involved in appellants' claims, i.e., the explained method of comparing the wafer table size to the wafer size and the half value width, is based on the structural elements of the claimed etching apparatus and the etching conditions used with the apparatus and leaves no room for introducing arbitrary labeling criticized by the Board in *Brummer* that may render the claim scope indefinite. Accordingly, the Examiner's application of *Ex parte Brummer* to appellants' claims is not proper.

The rejection of claims 2, 3, 8 and 9 as indefinite should be reversed.

B. Claims 2, 3, 8 and 9 Are Not Unpatentable Over Yanagisawa in view of Shinozuka.

On the requirements for a *prima facie* case of obviousness, MPEP 2143.03 states as follows:

> To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. ... All words in a claim must be considered in judging the patentability of that claim against the prior art.

> ... If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious.
>
> To support the obviousness rejection on appeal, the Examiner stated:
>
> Yanagisawa et al disclose a local etching apparatus, gas activated species, wafer table with support face larger than disclosed substrate (Fig 11). Yanagisawa et al do not disclose the radius of wafer table but disclose typical size of the nozzle to be 7 mm to 30 mm (Fig 15-16 and Col 2 lines 20-24). Shinozuka et al disclose an etch profile of a similar local dry etching application and show that etch depth is maximum at the central axis of the gas nozzle. Applying this to the situation where the nozzle is approaching the edge of the substrate, it is evident that for uniformity, the axis of the nozzle will have to reach at least the edge of the substrate. This would therefore mean that at least half of the etch spot would be lying outside the edge of the substrate or the radius of table would be 3.5 to 15 mm larger than the substrate. Since the claimed difference of radius of the substrate and the table is found disclosed, the underlying structure of claim 2 and 8 being equivalent, is disclosed as well.

Final Action, page 3. This is all the explanation the Examiner provided to support his rejection of claims 2, 3, 8 and 9 under 35 USC 103(a) on Yanagisawa in view of Shinozuka.

First, the Examiner failed to establish a case of *prima facie* obviousness because he did not show that the prior art teaches or suggests the limitation of claims 2 and 8 that the difference between the radius of the semiconductor wafer and the radius of the wafer table is 10 to 40 percent of a half value width of an etching rate distribution peak of the gas injected from the nozzle. Rather, the Examiner seems to contend that claims 2 and 8 are not patentable because the numerical limitations recited in claims 3 and 9, which depend from claims 2 and 8, respectively, are taught, at least under the Examiner's logic, by Yanagisawa and Shinozuka. Appellants point out that a teaching in the prior art of additional limitations recited in a dependent claim could not possible render the base independent claim unpatentable unless the prior art teachings disclose or suggest the limitations recited in the independent claim as well. As the Board recognizes, dependent claims incorporate all of the limitations of their base claims as a matter of law, so analyzing dependent claims by reference to the limitations stated in the words of the dependent claims ignores the limitations incorporated into those dependent claims from their base claims. To this extent, the Examiner's position is illogical.

The Examiner also failed to show why the numerical limitations of claims 3 and 9, if proven to be taught by the cited references, teach or suggest the limitations of the wafer table size of claims 2 and 8. "Thus the Board must not only assure that the requisite findings are made, based on evidence of record, but must also explain the reasoning by which the findings are deemed to support the agency's conclusion." *In re Lee*, 277 F.3d 1338, 1344, 61 USPQ2d 1430, 1442 (Fed. Cir. 2002). The record is devoid of evidence that supports the Examiner's position.

Second, the Examiner's contention that Yanagisawa and Shinozuka together provide the limitation that wafer table radius is lager than the wafer radius by 3.5 to 15 mm, which the Examiner equates to the limitations of claim 3 and 9 that the wafer table radius is larger than the wafer radius by 4 to 10 mm, does not withstand scrutiny. To come to this conclusion, the Examiner assumed that 1) the center axis of Yanagisawa's nozzle must move to the edge of the wafer, stop at the edge and start moving in the reverse direction, and that 2) the distance between the edge of the wafer and the edge of the wafer table is equal to half of the nozzle size, i.e., the nozzle radius. Both of these assumptions are required for the Examiner to find Yanagisawa's wafer and wafer table difference to be between 3.5 and 15 mm, the radii of two Yanagisawa's nozzles. Again, the Examiner failed to provide the reasons the cited references provide support for these assumptions. Especially with respect to the second assumption, the Examiner seems to contend that his assumption is supported because "at least half of the etch spot would be lying outside the edge of the substrate."

Appellants are at a loss why the condition that at least half of the etch spot lies outside the wafer would result in the conclusion that the distance between the edge of the wafer and the edge of the wafer table is equal to half of the nozzle radius. First, the nozzle size is not equal to the "etch spot" size, as the Examiner seems to contend. Second, persons of ordinary skill in the art would not have assumed that the distance between edge of wafer and the edge of the wafer table must be equal to the radius of the nozzle when the apparatus design is such that the center axis of

the nozzle rest at the edge of the wafer when the nozzle changes its moving direction. The Examiner's approach lacks support in the evidence.

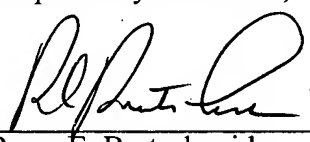
Thus, claims 2, 3, 8 and 9 are patentable over Yanagisawa and Shinozuka.

CONCLUSION

For the foregoing reasons, the Board should reverse the final rejection of claims 2, 3, 8 and 9 in this application.

In the event that the transmittal letter is separated from this document and the Patent and Trademark Office determines that an extension and/or other relief is required, appellants petition for any required relief including extensions of time and authorize the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952** referencing docket no. 506212000600.

Respectfully submitted,

Dated: October 7, 2004 By: 

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APPENDIX OF CLAIMS ON APPEAL

2. A local dry etching apparatus for removing unevenness on a surface of a semiconductor wafer, comprising:

a nozzle from which a gas including an activated species produced by a plasma is injected locally to the surface of the semiconductor wafer; and

a wafer table supporting the semiconductor wafer concentrically thereon, a radius of the wafer table being larger than a radius of the semiconductor wafer,

wherein a difference between the radius of the semiconductor wafer and the radius of the wafer table is 10 to 40 percent of a half value width of an etching rate distribution peak of the gas injected from the nozzle.

3. The local dry etching apparatus of claim 2, wherein the radius of said wafer table is larger than the radius of said semiconductor wafer by 4 mm to 10 mm.

8. A wafer table for a local dry etching apparatus for removing unevenness on a surface of a semiconductor wafer by injecting a gas including an activated species produced by a plasma through a nozzle locally to the surface of the semiconductor wafer supported on and concentric with the wafer table,

wherein a radius of the wafer table is configured to be larger than a radius of the semiconductor wafer supported on the wafer table so that a difference between the radius of the semiconductor wafer and the radius of the wafer table is 10 to 40 percent of a half value width of an etching rate distribution peak of the gas injected from the nozzle.

9. The wafer table of claim 8, wherein the radius of the wafer table is larger than the radius of said semiconductor wafer by 4 mm to 10 mm.